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# Target Design, Fabrication, and Injection Considerations for Inertial Fusion Energy

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## Abstract

A potential application of Inertial Confinement Fusion is the production of electricity in inertial fusion energy (IFE) power plants. Conceptual design studies of power plants have identified likely operating parameters considering the projected cost, performance and design constraints for drivers (laser and ion accelerators), targets, fusion chambers, and energy conversion systems. Typical parameters of interest to target developers from the most recent power plant studies include:

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| Driver energy | 3 - 7 MJ |
| Target gain | 80 - 120 |
| Target yield | 400 - 700 MJ |
| Pulse rate | 3 - 7 Hz |

A single power plant operating at 5 Hz requires ignition of about 120 million targets per year (assuming the plant has an availability factor of about 75%). This will require the development of automated production, handling and quality control techniques capable of these high production rates at a cost per target on the order of 25¢ or less. In addition, these targets must be injected into the fusion chamber - being accelerated at over 1000 $m/s^2$ to velocities on the order of 200 m/s. The targets must survive not only the injection process, but also heating from the surrounding chamber environment. Materials used to fabricate targets for IFE must be compatible with the operation of the chamber (e.g., recoverable from the liquids typically used to protect the chamber walls) and recyclable into new targets once recovered. Neutron activation of the selected material is thus a concern for refabrication and handling. The design of the target factory must be very reliable so that it does not compromise the availability of the power plant. Redundant, parallel production lines have been proposed to increase reliability. To reduce the risk from accidental release, the tritium inventory of the target factory should be minimized by minimizing the production time (e.g., by developing fast DT fill techniques) and minimizing the inventory of completed targets. For example, a 1 $GW_e$ power plant requires injection of ~ 1 kg of tritium per day, a third of which is burned in the fusion process. In this talk we describe examples of IFE target designs (including possible material choices), considerations for automated production, and implications of target injection process. Key issues and R&D needs are identified.

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